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(54) A corrugated scaffolding tube and its manufacture

(57) A method of manufacturing a tube 1 comprises the steps of: forming a tube from an uncured plastics material; curing an inner surface 2 of the tube to form a fully cured central core; moulding the uncured outer surface 3 of the tube into a desired shape; and fully curing the outer surface of the tube. The outside of the tube may be corrugated, and the tube can be used in scaffolding. Clamps with corrugated inserts (figs. 2, 3, 4, not shown) are used to prevent movement of the tube relative to the clamp. The tube may be formed by pultrusion of glass fibre, carbon fibre or aramid with polyester, vinyl ester or epoxy resin. In an alternative method, the tube is entirely cured in the first curing step, and an outer layer is then moulded onto the tube and subsequently cured.

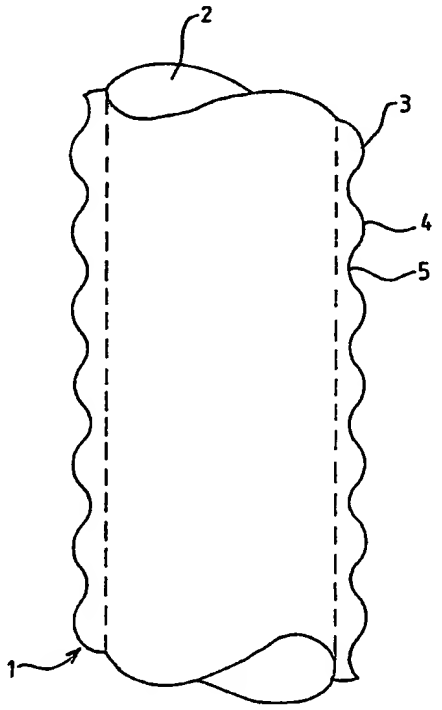

FIG 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

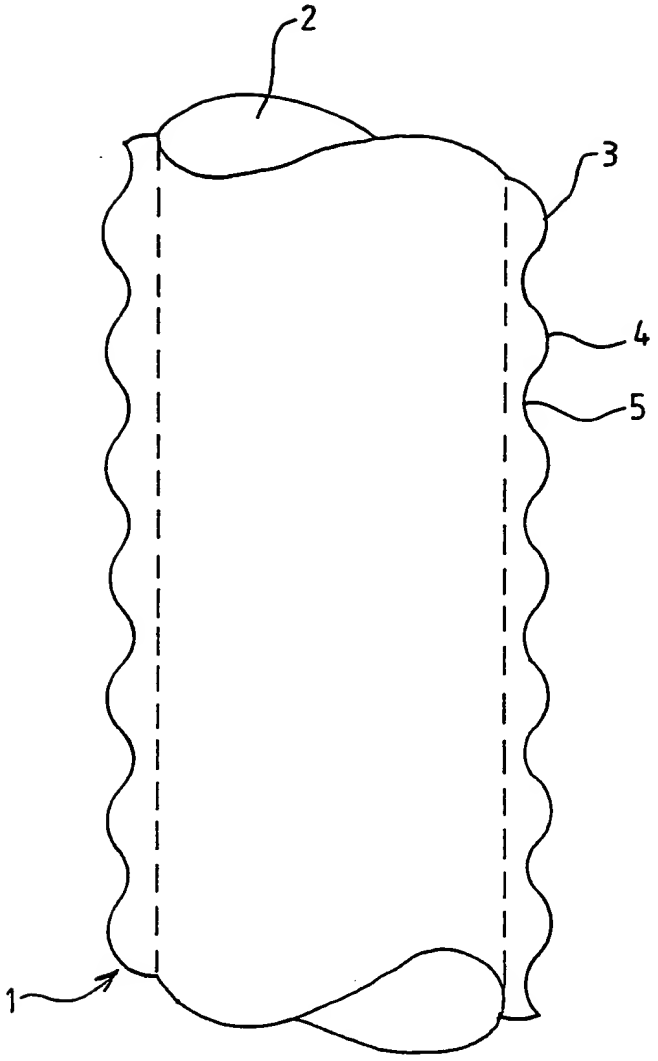

FIG 1

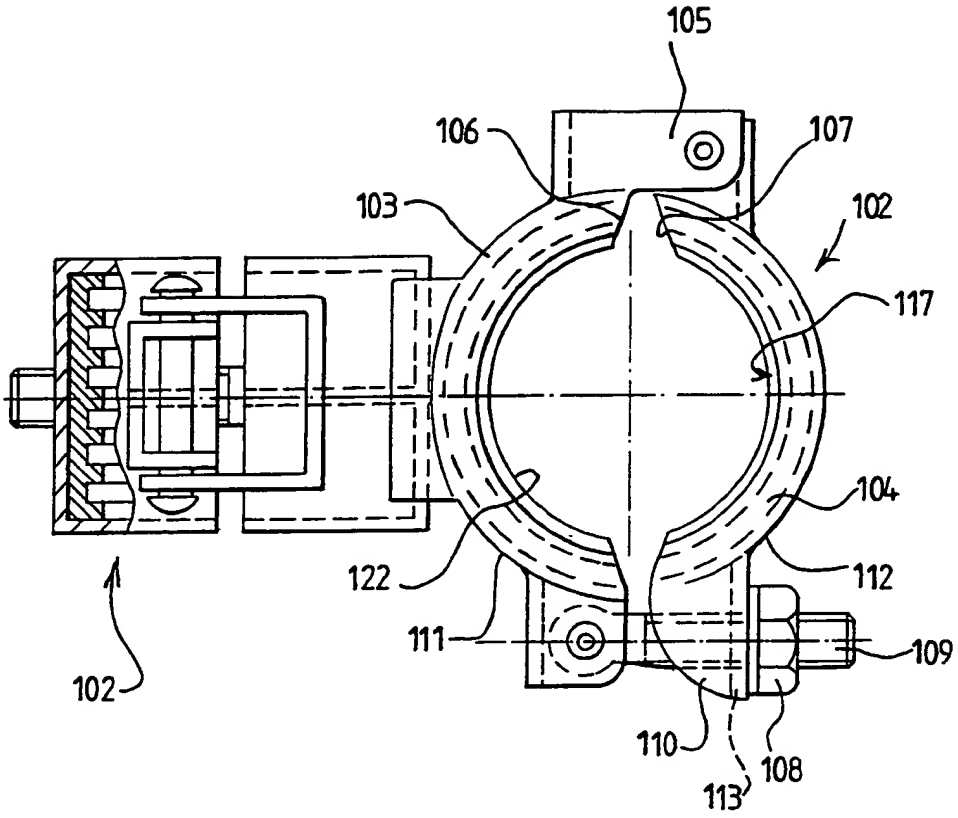

FIG 2

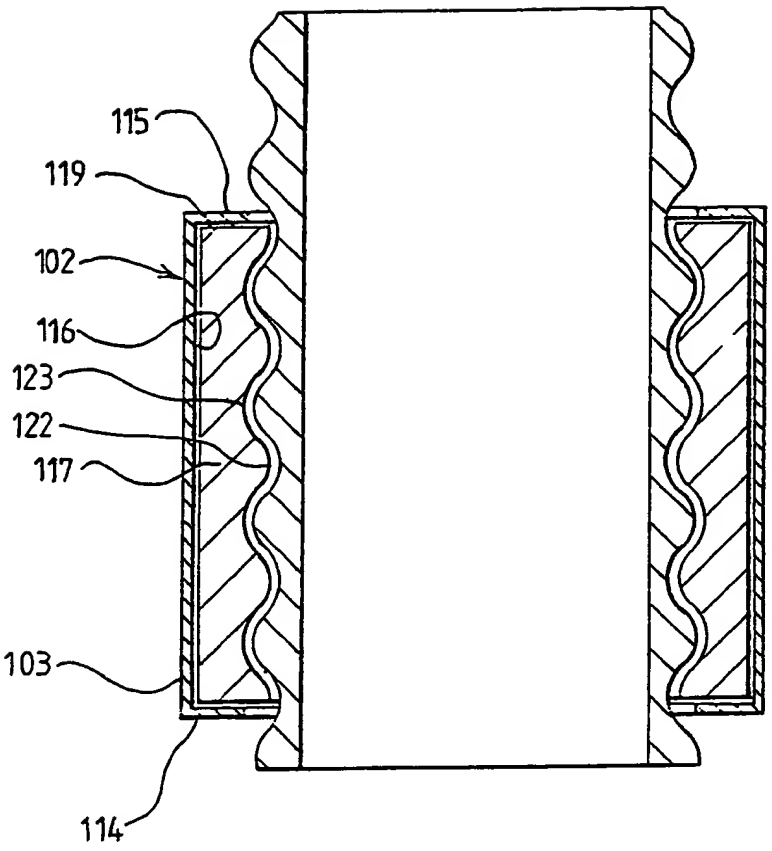

FIG 3

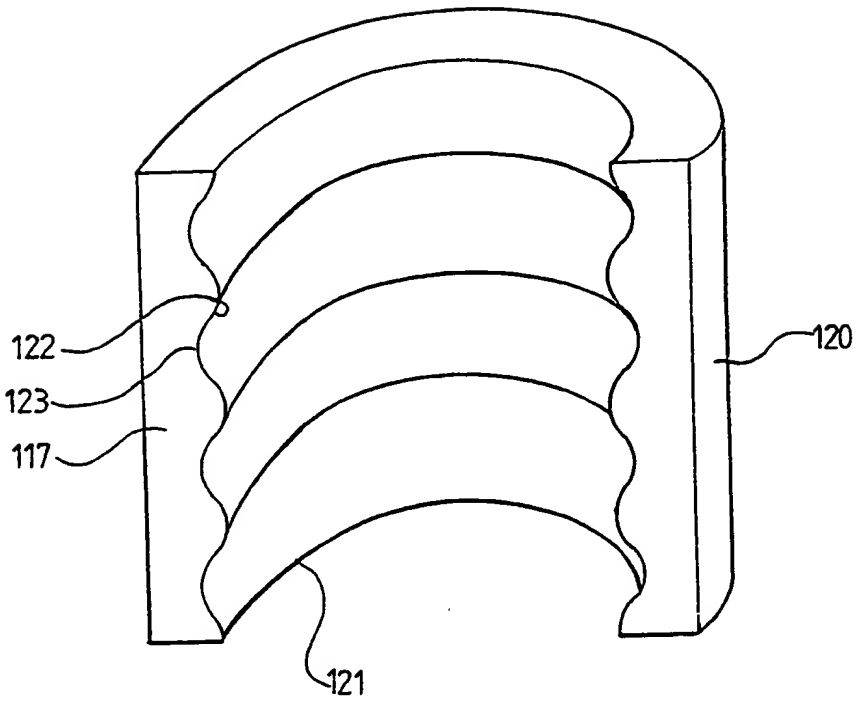

FIG 4

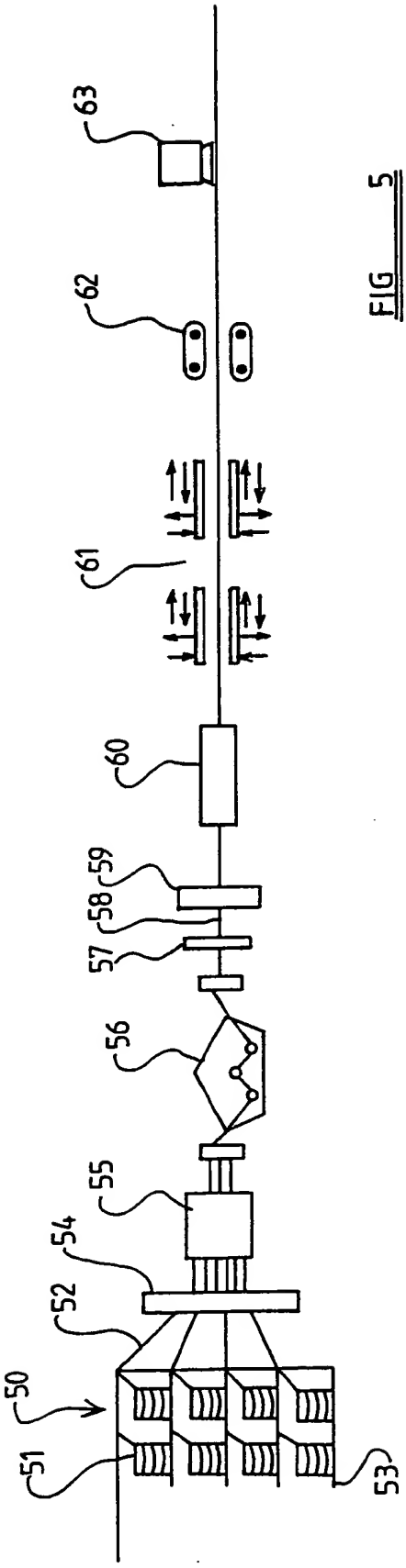
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FIG 5

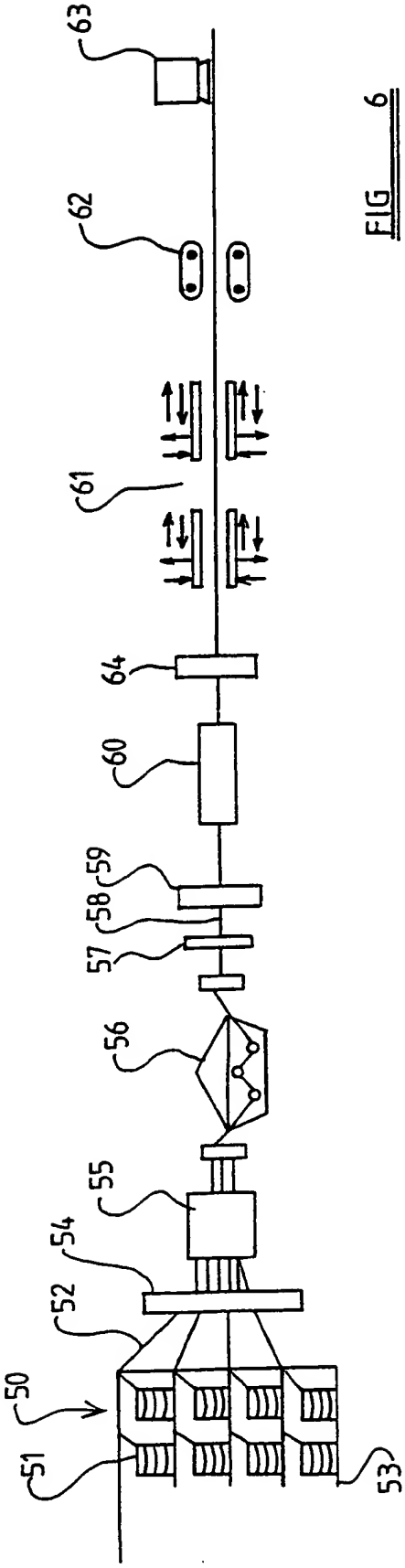
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FIG 6

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"A tube and method of manufacturing the same"

The present invention relates to a tube and a method of manufacturing the tube. More particularly, the present invention relates to a scaffold tube for use in constructing scaffolding structures.

In conventional scaffolding structures it is a common practice to construct the upright members, horizontal members and braces using aluminium, steel or metal alloy tubing. Such tubing is heavy and it would be advantageous to use a lighter alternative such as a plastics tube reinforced by, for example, carbon fibre, fibreglass or aramid. Scaffold tubing normally has a smooth outer surface.

Accordingly, the present invention provides a method of manufacturing a tube comprising the steps of: - forming a tube from an uncured plastics material; - curing an inner surface of the tube to form a fully cured central core; - moulding the uncured outer surface of the tube into a desired shape; and - fully curing the outer surface of the tube.

Another aspect of the present invention provides a scaffold tube for use in constructing scaffolding structures or the like, which tube has an outer surface formed with one or more contoured portions.

In order that th present invention may be more readily understood, embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side view of a length of tube embodying the present invention;

Figure 2 is a side view of a coupling joint comprising two scaffold clamps of the type shown in Figure 2, one of the scaffold clamps being shown in partial cross section to illustrate the profile of its insert;

Figure 3 is a cross section through a tube embodying the present invention and a scaffold clamp holding the tube;

Figure 4 is a perspective view of an insert for use with the scaffold clamp shown in Figure 2;

Figure 5 is a schematic diagram illustrating a method according to the present invention of manufacturing the tube shown in Figure 1; and

Figure 6 is a schematic diagram illustrating another method according to the present invention of manufacturing the tube of Figure 1.

As shown in Figure 1, a tube 1 embodying the present invention comprises an elongate cylinder having an inner surface 2 and an outer surface 3. The inner surface 2 is smooth and of constant diameter whilst the outer surface 3 is contoured with annular corrugations which form alternating ribs 4 and grooves 5 at regular intervals along the length of the tube 1.

The tube 1 is preferably manufactured from fibre reinforced plastics. In particular, the use of fibre glass, carbon fibre and aramid is preferable. It is, however, envisaged that a non-fibre reinforced plastics material can be used.

In an embodiment of the tube 1 according to the present invention not shown in the drawings, the annular ribs 4 defined on the outer surface 3 of the tube 1 may be replaced with a single or multi-start thread, thereby enabling rotation of a scaffold clamp 102 (see Figure 2) provided with a similarly threaded insert 117 around the tube 1 to move the scaffold clamp 102 either up or down the tube 1 as desired.

The above described tube 1 is particularly suited for use with the scaffold clamp shown in Figure 2. The corrugations which are formed at regular intervals along the tube 1 correspond to the intervals between the regularly spaced apart ribs 122 of the inserts 117 of the scaffold clamp 102.

Figure 2 shows a coupling joint 101 for use with the tube 1 of the present invention comprising two scaffold clamps 102. Each scaffold clamp 102 is generally cylindrical in form and comprises two semi-cylindrical jaw members 103, 104 which are joined together by a hinge 105 formed along two edges 106, 107 which extend axially along the clamp 102. The clamp 102 is hingeable from a closed position, in which the two semi-cylindrical jaw members 103, 104 form a cylinder, to an open position in which the two jaw members 103, 104 are fully hinged apart.

When in the closed position, the two jaw members 103, 104 can be locked together by a locking nut 108 and

bolt 109 and a clasp 110. The bolt 109 is hingedly mounted on an outer surface 111 of one jaw member 103 and the clasp 110 is rigidly mounted on an outer surface 112 of the other jaw member 104. The clasp 110 is adapted to receive the bolt 109 in a slot 113 such that the nut 108 can be threaded down the bolt 109 to come into contact with, and lock against, the clasp 110. Figure 4 shows both scaffold clamps 102 in the closed and locked position, the two jaw members 103, 104 of each clamp 102 being locked by their respective locking nut 108 and bolt 109 onto their respective clasp 110.

To unlock the two jaw members 103, 104 the locking nut 108 is threaded away from the clasp 110 and then the bolt 109 is hinged out of the slot 113. The jaw members 103, 104 can then be moved apart into the open position.

Both axial ends of each jaw member 103, 104 are formed with annular lips 114, 115 which face radially inward. Thus, an inner surface 116 of each jaw member 103, 104 is bounded at its axial ends by the lips 114, 115. An insert 117, shown separately in Figure 4, conforms to the shape of the inner surface 116 of each of the jaw members 103, 104 and an insert 117 is securely fastened onto each of the inner surfaces 116 of the jaw members 103, 104 by adhesive or other means. The inserts 117, as well as being secured by adhesive or other means to the jaw members 103, 104 are prevented from moving axially with respect to the jaw members 103, 104 by means of the lips 114, 115 which abut two opposite ends 118, 119 of both of the inserts 117.

An insert 117 has two main surfaces. An outer surface 120 is convex and conforms to the shape of the inner surface 116 of the jaw members 103, 104 to which it is fastened. The other surface 121 is opposite the convex

surface 120 and is concave. The concave surface 121 is formed with a plurality of regularly spaced apart ribs 122 which define grooves 123 therebetween. The ribs 122 and grooves 123 run parallel with the inwardly turned lips 114, 115, that is annularly around the concave surface 121 and perpendicularly to the axial direction. When the clamp 102 is in the closed position, the ribs 122 and grooves 123 define substantially circular corrugations within the clamp 102. The ribs 122 in the insert 117 in one jaw member 103 are disposed opposite to and are aligned with the ribs 122 in the other jaw member 104 to which the first jaw member 103 is hinged. The same applies to the grooves 123.

To hold the contoured or corrugated tube 1 formed with the annular ribs 4 and grooves 5, the clamp 102 is placed in the open position and the ribs 122 and grooves 123 of one insert 117 are registered with the ribs 4 and grooves 5 of the tube 1. The jaw member 104 holding the other insert 117 is closed around the tube 1, thereby fully encircling the circumference of the tube 1. All the ribs 122 and grooves 123 of both inserts 117 are then registered with the corresponding ribs 4 and grooves 5 of the tube 1. The locking nut 108 and bolt 109 and clasp 110 are used to lock the clamp 102 in this closed position. As can be seen from Figure 3, it is possible to use inserts 117 having a profile which is complementary to that of the profile defined by the corrugated tube 1, thus evenly spreading any loads placed on the scaffold clamp 102 onto the tube 1. Because of the corrugated form of the outer surface 3 of the tube 1 in combination with the ribs 122 and grooves 123 formed in the inserts 117, the clamp 102 cannot move axially with respect to the tube 1 but is capable of rotation around the tube 1. Thus, there are no undue compressive stresses around the tube 1 to cause any deformation of the tube 1 which would otherwise occur when

using a conventional plastics tube in combination with a conventional scaffold clamp. If the locking nut 108 is tightened further onto the clasp 110 then the ability of the clamp 102 to rotate about the tube 1 can also be removed.

In one embodiment of the tube 1, the profile of the corrugations of the tube 1 is determined by finite element analysis to avoid any stress concentrations.

Figures 5 and 6 illustrate two methods of manufacturing the tube 1 in accordance with the present invention.

In the first method shown in Figure 5, a plurality of rovings 50 each consisting of continuous strand 52 of, for example, glass fibre, are carried on bobbins 51. The rovings 50 are held in an array upon a roving shelf 53. The fibres 52 are fed into a fibre guide 54 which aligns and feeds the fibres into a drying chamber 55 which removes any excess moisture from the fibres 52. The dried fibres 52 are then passed through a resin tank 56 so that all the fibres 52 are fully impregnated with the resin held in the tank 56. The resin impregnated fibres 52 are then fed into another guide 57 which weaves the individual fibres 52 into a laminate 58 which is, in turn, fed into a winding head 59 which weaves the laminating 58 into a tube 1.

The above described steps are known in the art and are sometimes referred to as a pultrusion process.

The tube 1 formed by this process comprises an elongate cylinder having smooth inner and outer surfaces. This tube 1 is passed onto a pultrusion heating die 60.

The pultrusion die 60 fully cures the inside surface 2 of the tube 1 thereby forming a hard annular core on the inner surface 2. The outer surface 3 is only partially cured by the pultrusion die 60. The pultrusion heating die 60 is temperature controlled to control the curing process.

With the outer surface 3 of the tube 1 in this partially cured state, the tube 1 is passed onto a compression mould 61 which functions to mould the shape of the corrugations onto the partially cured outer surface 3, the inner surface core being adequately cured to withstand the pressure exerted by the compression mould 61. As well as moulding the outer surface 3 of the tube 3, the compression mould 61 also serves to fully cure the outer surface 3 of the tube so that the entire tube 1 is fully cured. The compression mould 61 can then be removed from the tube 1 which is pulled from the compression mould 61 by pulling means 62. The finished tube 1 can be cut into desired lengths by a cutter 63.

The entire process is designed to be a continuous process and hence the compression mould 61 is capable of travelling along with the tube 1 as it is being cured and moulded.

In another method of manufacturing the tube 1 in accordance with the present invention and as shown schematically in Figure 6, the tube 1 exits the pultrusion heating die 60 in a fully cured and hardened state. To form the contouring or corrugation on the outer surface 3 of the tube 1, a further winding head 64 is provided after the pultrusion heating die 60. The further winding head 64 adds a layer or layers of resin impregnated fibre 52 to the tube 1 to form an uncured laminate on the outer surface 3 of the tube 1. The uncured laminate can then be cured, as

in the previously described method, by being fed through the compression mould 61 which also moulds the contours or corrugations onto the outer surface 3 of the tube 1. The fully cured tube 1 is then pulled and cut as previously described. Preferably, this process is also a continuous process.

Preferably, the fibres used are: glass fibre, carbon fibre or aramid and the resins used are thermosetting resins such as polyester, vinylester or epoxy.

CLAIMS:

1. A method of manufacturing a tube comprising the steps of: forming a tube from an uncured plastics material; curing an inner surface of the tube to form a fully cured central core; moulding the uncured outer surface of the tube into a desired shape; and fully curing the outer surface of the tube.

2. A method according to Claim 1, wherein after forming the tube from an uncured plastics material, the outer surface of the tube is fully cured as well as the inner surface and then the outer surface of the fully cured tube is provided with a further layer or layers of uncured plastics material.

3. A method according to Claim 1 or 2, wherein the inner surface of the tube is cured by a pultrusion heating die, the temperature of which is controllable.

4. A method according to any preceding claim, wherein the outer surface is moulded with one or more annular corrugations.

5. A method according to any preceding claim, wherein the manufacturing process is a continuous feed process, the means for curing and moulding the tube being movable in the feed direction.

6. A method according to any preceding claim, in which the plastics material is reinforced with fibre.

7. A method according to Claim 6, in which the reinforcing fibre comprises glass fibre, carbon fibre and/or aramid.

8. A method according to any preceding claim, in which a thermoset resin is used as the plastics material.

9. A method according to Claim 8, in which the thermoset resin is polyester, vinylester or epoxy resin.

10. A scaffold tube for use in constructing scaffolding structures or the like, which tube has an outer surface formed with one or more contoured portions.

11. A tube according to Claim 10, wherein the contoured portion comprises one or more annular corrugations.

12. A tube according to Claim 10, wherein the contoured portion comprises a screw thread.

13. A tube manufactured in accordance with the method of any one of Claims 1 to 9.

14. A method of manufacturing a tube substantially as hereinbefore described with reference to Figure 5.

15. A method of manufacturing a tube substantially as hereinbefore described with reference to Figure 6.

16. A tube substantially as hereinbefore described with reference to and as shown in Figures 1 and 3.

17. Any novel feature or combination of features disclosed herein.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (Th Search report) -11-	Application number GB 9319771.3
Relevant Technical Fields (i) UK Cl (Ed.L) B5A (AA1, AA3, AT18P, AD24P) (ii) Int Cl (Ed.5) B29C (69/02; B29D (23/00, 23/18, 23/22)	Search Examiner J P STEVENS Date of completion f Search 26 NOVEMBER 1993
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-9, 14, 15

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X,Y	GB 2262470 A	(SHAW) see especially Claims 1 and 30, page 6 lines 16 and 17	X: 1,2,6-8 Y: 4,5
Y	WO 91/00797 A1	(UPONER) see especially figures	4,5

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